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(58) Field of search
A5R
Selected US specifications from IPC sub-class A61M

(54) Limited re-usage disposable syringe

(57) A syringe comprises a two part (4,6) piston, wherein on the first filling both sections (4,6) move together. On the first injection stroke, the rearward section (6) of the piston is retained by the end-cap (3) of the syringe whilst the forward section (4) forces the injectant out of the needle because the one-way valve (9) in that section (4) is closed. Further attempts to re-fill the syringe will be unsuccessful because the one-way valve (9) then opens thus equalising the pressure in both chambers on either side of the forward section (4) of the piston through passages (8) and hence further injectant is not sucked into the syringe.

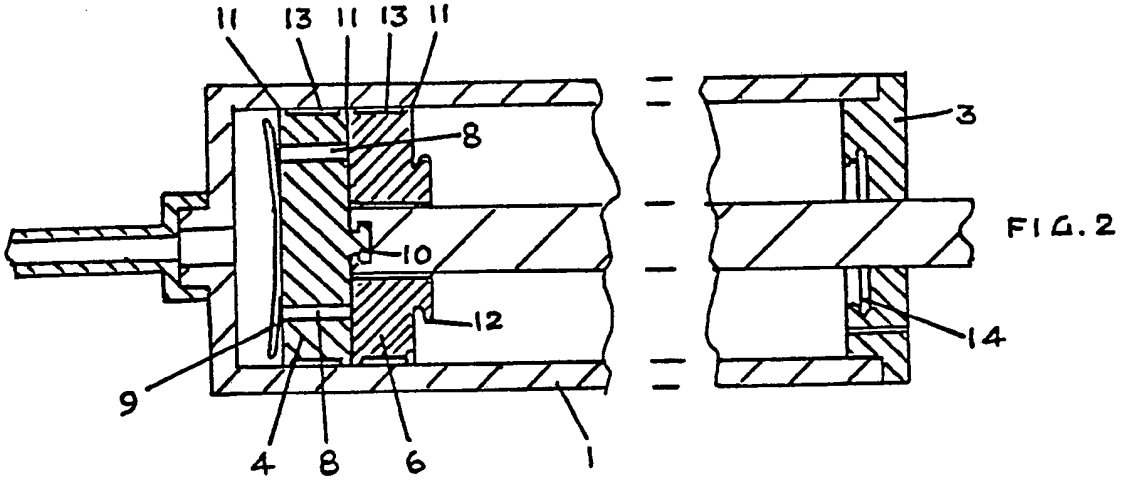

FIG. 2

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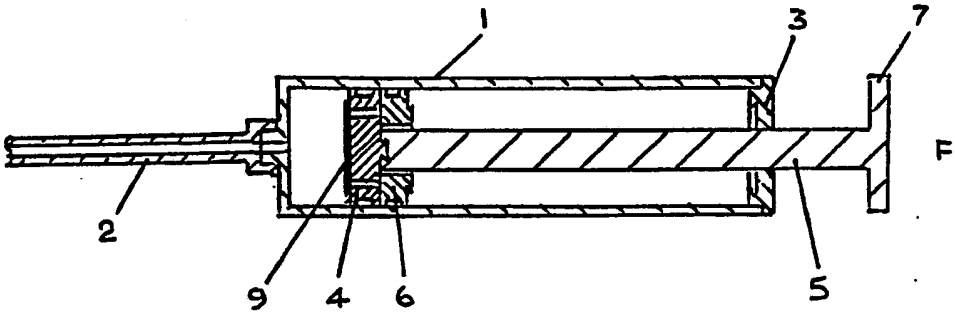

FIG. 1

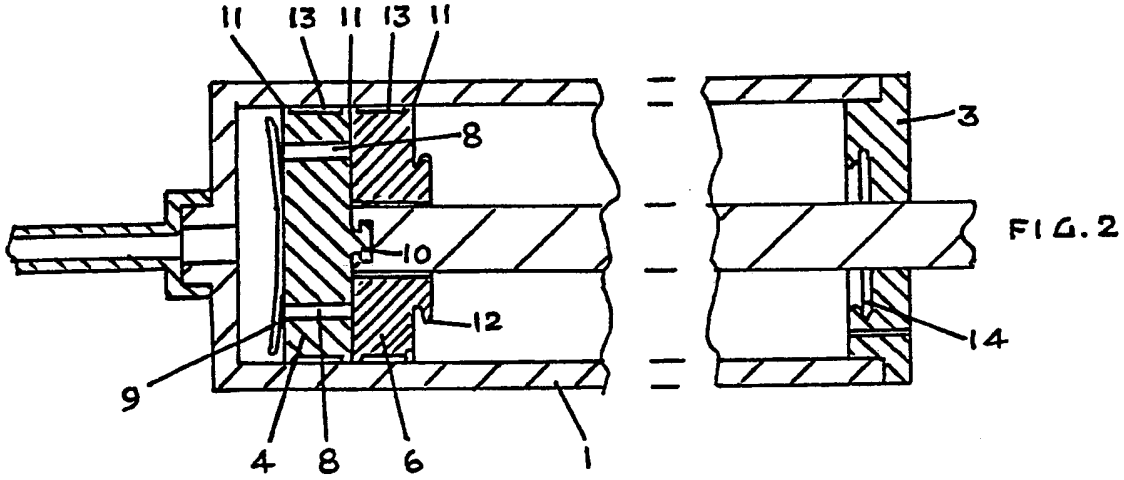

FIG. 2

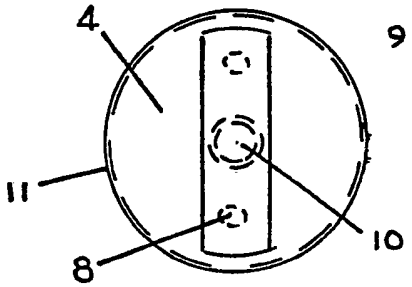

FIG. 3

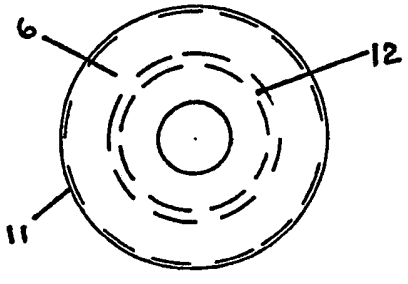

FIG. 4

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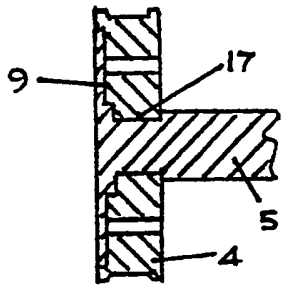

FIG.5

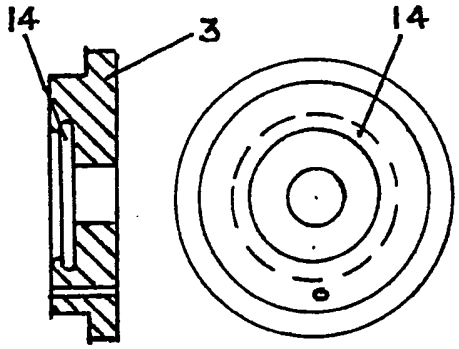

FIG. 6 FIG. 7

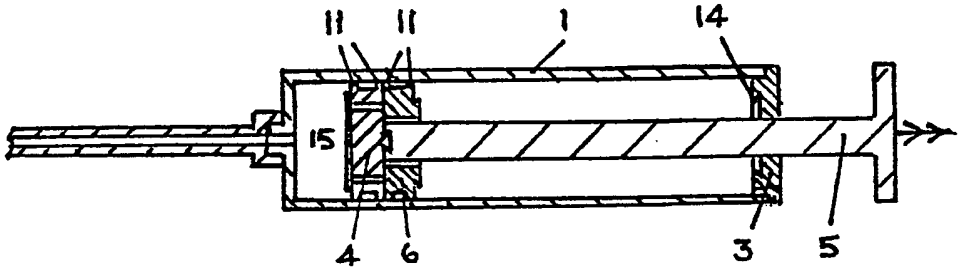

FIG. 8

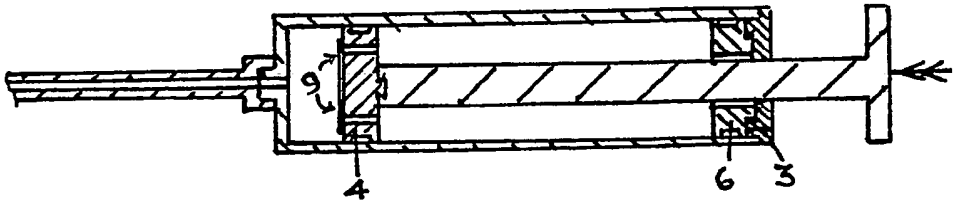

FIG. 9

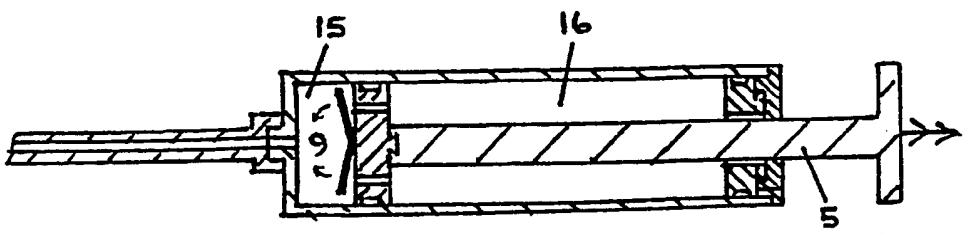

FIG. 10

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LIMITED RE-USAGE DISPOSABLE SYRINGE

This invention relates to a limited re-usage disposable syringe.

Syringes are widely used in medical and vetinary practice. Syringes are disposable and designed for single-use, however, there is no limiting features to ensure this and if so wanted they could be used repeatedly with or without medical supervision. A syringe when used more than once can become a vehicle to spread disease e.g. Hepatitis B, AIDS, especially if used non-medically e.g. Drug abusers. A 'single-use' syringe used repeatedly could allow the contamination of specimens, drugs etc. The intention of this syringe is to limit its use to one complete injection only.

There are broadly two designs of syringe, either the piston/plunger inside a barrel or the compressible bellows variety. The basic principle for both types is similar, when drawing fluid into the syringe a reduced pressure needs to be created behind the needle. This can be achieved by withdrawing the piston/plunger or by the operation of the bellows type device. When the pressure is manually increased the injectant is expelled from the syringe.

According to the present invention there is provided a limited re-usage disposable syringe which includes a compound piston arrangement comprising of at least a forward and a rearward section.

The actual manual operation of this syringe is similar to currently available syringes. The essential differences relate to the design and operation of the piston section which is shown more clearly in the later Figures 1 - 9.

It is well known that the piston needs to have sufficient contact with the barrel wall so that a lowering of pressure within the syringe can be created in order to draw the injectant into the syringe and to subsequently force it out through the needle as required. The compound piston of the present invention, being made entirely of, or at least where contact with the

barrel wall is required, a flexible or rubber-like material, achieves this. In contrast to conventional pistons this new piston is of a compound form and is composed of two sections. The forward section, nearest to the needle, acts when necessary, as a non-return valve. This is achieved by conventional means or more specifically by a flap-valve arrangement which closes off one or more channels or orifices during the injection stroke. Such a valve would form part of the forward section of the compound plunger either being made integral to the plunger during the production process or being attached at a later stage. The resultant forward section would be of such dimension as to provide a liquid/gas seal with the barrel wall and would be attached to the plunger either as an integral part or via a locking device. The rearward section of the compound piston would also be of such dimensions as to provide a liquid/gas seal with the barrel wall. Additionally it would also provide a liquid/gas seal with the forward section of the compound piston via their contact surfaces when they are moving as one combined piston. Additionally the rearward section of the compound piston would contain a clearance hole for the plunger to ensure that the frictional forces with the barrel wall are greater than those with the plunger. A further design feature of the rearward section of the compound piston is that means are provided such that it is retained at the end-cap end after the first full filling stroke. This can be achieved by annular protrusion on the barrel wall or more advantageously by being able to lock onto or into the end-cap or plate. If the flow-rate of air through the forward section needs to be increased this can be achieved by increasing the number of holes or channels or by increasing their size. With regard to this it would be advantageous to include a protrusion or protrusions on the front face of the rearward section of the compound piston which form a loose fit with the corresponding holes through the forward section of the compound piston. Such a modification would assist in making the liquid/gas seal between the two sections of the

compound piston as required during the injection stroke.

Whilst a syringe of the aforementioned type can be thrown away after use it would be advantageous if it were constructed from combustible materials. Thus it is envisaged that the syringe would largely be made from a thermoplastics resin. The preferred but not exclusive method of manufacture would be by injection moulding. This, of course, would not exclude the use of adhesives, heat sealing or other methods of bonding contacting surfaces as required during the manufacturing process. As mentioned earlier the sections of the compound piston would be wholly or at least partially made from a flexible or rubber-type material of the required flexibility and chemical resistance. From an understanding of the operation and function of the syringe it should be clear that the syringe would need to have both sections of the compound piston fully forward at the needle end prior to filling with injectant.

The function and operation of this novel syringe should be clear from the following figures, which are not scaled drawings, and the accompanying explanations.

Figure 1 - general cross-section of the syringe.

Figure 2 - enlarged cross-section of the compound piston.

Figure 3 - end-view of the forward section, viewed from the needle end.

Figure 4 - end-view of the rearward section viewed from the needle end.

Figure 5 - alternative method of attaching the forward section to the plunger.

Figure 6 - cross-section of the end-cap

Figure 7 - end-view of the end-cap, viewed from the needle end.

Figure 8 - syringe during the filling stroke.

Figure 9 - syringe during the injection stroke.

Figure 10 - syringe during an attempted further filling stroke.

As shown in Fig 1 the syringe essentially comprises a barrel 1 fitted with an injection needle 2, which may be on or off the centre-line of the syringe, at one end and an end-cap or plate 3 at the other. The forward section 4 of the compound piston, containing the flap-valve 9, which may be recessed into 4, is attached to the plunger 5 as in Fig 2 or Fig 5. This forward section is initially in contact with the rearward section of the compound piston 6. The non-piston end of the plunger includes an enlarged end-piece 7, which may be part of or a later addition to the plunger, so as to aid manual movement of the plunger.

Referring now to Figs 2, 3 and 4. The forward section of the piston 4 contains one or more orifices or channels 8 which pass completely through the piece. These are closed by, for example a flap-valve 9 which for the purposes of clarity is shown partly open. The forward section additionally has a protrusion 10 on the rearward face which engages with the plunger. Such a fixing, not shown in the figures, could obviously be provided by a recess in 4 which engages with a protrusion in 5. Alternatively the modification shown in Figure 5 could be used. Whilst the forward section's surface in contact with the barrel wall may be of uniform diameter it is envisaged that a recessed section 13 would be more appropriate thus leaving actual contact with the barrel wall to the full diameter regions 11.

The rearward section of the compound piston 6 is provided with a recess 13 and contact with the barrel 11 so as to achieve the necessary liquid/gas seal. The forward face of 6 also makes a liquid/gas seal with the rearward face of 4 when required and is additionally provided, if necessary, with protrusions (not shown) which form a loose-fit with the orifices or channels 8

in the forward section. The central hole in 6 is of such dimension as to provide clearance with respect to the plunger. Additionally, as a required feature, the rearward face has a protrusion 12 which can engage and lock into a corresponding recess 14 in the end-cap 3. Alternatively, but not shown, this locking could be via a protrusion in the end-cap and a corresponding recess in the rearward section of the compound piston.

An alternative version of the forward section and plunger is shown in Fig 5. In this the forward end of the plunger has a moulded flange incorporating the flap-valve 9. Additionally there is a reduced section 17 at the forward end of the plunger which retains the forward section of the compound piston during the movements of the plunger.

Fig 8 shows the operation of the syringe during the first filling operation. In this case both sections of the compound piston 4 and 6 move as one away from the needle end as the plunger is withdrawn. The liquid/gas seals between the compound piston and the barrel wall and between the two sections' contacting surfaces produces a lower than atmospheric pressure in the forward chamber 15, thus sucking up the injectant into the syringe. On complete withdrawal of the plunger the rearward protrusion 12 of the rearward section of the compound piston enters and is retained in the recess 14 of the end-cap or plate.

During the injection stroke, as depicted in Fig 9, the rearward section of the compound piston remains held in the end-cap whilst the forward section, because of the movement of the plunger, moves towards the needle end of the syringe. In moving in such a way the injectant causes the flap-valve 9 to close and hence the injectant is progressively expelled through the needle.

Fig 10 shows the operation of the syringe if a second attempt is made to fill the syringe. When the plunger is withdrawn the flap-valve 9 opens such that the potentially higher air pressure in the rearward chamber 16 is

automatically adjusted such that the air pressures in chambers 15 and 16 are equalised. As a result of this no injectant will enter chamber 15 of the syringe.

Whilst the purpose of this invention is to prevent a second filling of the syringe this relies on the assumption that the plunger will have been fully withdrawn during the first filling. In the unlikely case where the syringe has only been partially filled any subsequent attempt to refill the syringe can only partially be achieved. It should be clear that following a partial filling and subsequent injection, the rearward section of the piston 6 will have separated from the forward section and remained in a position consistent with the position reached when withdrawal of the plunger ceased. It is obvious from the operation of the syringe that no injectant will enter the syringe, during a refilling attempt, until the two sections of the compound piston again begin to act as a unified compound piston. Thus only a limited amount of injectant will be sucked into the syringe.

CLAIMS

1. A limited re-usage disposable syringe which includes a compound piston arrangement comprising of at least a forward section and a rearward section.

2. A limited re-usage disposable syringe as claimed in Claim 1 wherein the sections of the compound piston form a gas and liquid seal with the barrel of the syringe.

3. A limited re-usage disposable syringe as claimed in Claim 1 and Claim 2 wherein the sections of the compound piston form a gas and liquid barrier when they are in contact with each other.

4. A limited re-usage disposable syringe as claimed in Claim 3 wherein the sections of the compound piston have individually different functions during the suction and injection strokes.

5. A limited re-usage disposable syringe as claimed in any preceding Claim wherein the forward section of the compound piston contains at least one orifice which depending on the direction of movement of the plunger is either open or is closed by a non-return valve mechanism.

6. A limited re-usage disposable syringe as claimed in Claim 5 wherein the forward section of the compound piston is attached to the plunger.

7. A limited re-usage disposable syringe as claimed in Claim 6 wherein the non-return valve mechanism of the forward section of the compound piston is integral with, within or attached to the forward section.

8. A limited re-usage disposable syringe as claimed in Claim 5 wherein the rearward section of the compound piston contains a clearance hole for the plunger such that any friction with the plunger is less than that of the rearward section and the barrel wall of the syringe.

9. A limited re-usage disposable syringe as claimed in Claim 8 where the rearward section of the compound piston is provided with a device which

engages with and locks with the end-cap or end-plate of the barrel of the syringe.

10. A limited re-usage disposable syringe as claimed in Claim 5 wherein the end-cap or end-plate is provided with a means to retain the rearward section.

11. A limited re-usage disposable syringe as claimed in Claims 1 - 10 wherein operation of the syringe by the operator is essentially the same as required for conventional syringes.

12. A limited re-usage disposable syringe substantially as described herein with reference to Figures 1 - 10 of the accompanying drawings.